Modeling of Absorption of Seismic Waves SOV/49-58-7-2/16

There are 5 figures and 42 references, 7 of which are English, 4 German and 31 Soviet.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki Zemli (Institute of Terrestrial Physics, AS USSR)

SUBMITTED: April 18, 1957

Card 10/10 1. Seismic waves--Absorption 2. Mathematics--Applications

SOV/ 49-58-11-3/18

AUTHOR: Ivakin, B. N.

TITLE: Computation and Modeling of Absorption of Seismic Waves (Raschet i modelirovaniye pogloshcheniya seysmicheskikh voln)

PERIODICAL: Izvestiya Akademii Nauk SSSR, Seriya Geofizicheskaya, 1958, Nr 11, pp 1288-1309 (USSR)

ABSTRACT: Following the work in Seriya Geofizicheskaya, Nr 7, 1958 on modulation of seismic waves based on the physical models of various mediums, further experimentations were carried on in the Institute of Physics of the Earth, Ac.Sc. USSR. The results are described below. The computation in the case of the electric model of the medium with elastic reaction was carried out with the application of the formulae for a constant of distribution q_o (Eqs. 1 and 2), the coefficients of phase dislocation β_o' and of absorption α_o' (Eqs.3-6). The velocity of distribution (Eqs. 7,8) in this case was considered with the coefficient of absorption α_o' (ω) as being equal to zero (i.e. the absorption being very small). The decrement of absorption along the wave length was defined

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Computation and **Modeling** of Absorption of Seismic Waves

as Eqs.(9) and (10). The wave resistance $|W|$ was found from Eqs.(11), (12). The module of wave resistance was expressed as the relation of amplitude of absorbing wave P to the amplitude of wave velocity V. As the experimentations were carried out with the electric model, the parameters (13) were taken into consideration in the formulae (5), (7), (10) and (12), the expressions (14 to 17) describing the electric model of motion with reaction were obtained. The comparison between theoretical and natural models were calculated from (7), (10) and (12) and presented as (18) where F_c, F_Δ, F_W and F_Θ are functions of invariants (19), (20) in general, and (21), (22) for electrical and mechanical models. As an example, the parameters (23) can be applied in the case of sandstone with the modulation of absorption carried on at $\omega = 500\ 000$ ($f_M = 80$ kh). For application of the criterion (19) the values of β_o and λ_o are expressed as (24). Similarly in the case of the electric model the values (25) were applied. The expression (26) can be considered

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Computation and Modeling of Absorption of Seismic Waves

when the parameter L_o for the electric model is taken as unity (ten cells of the model equal to 1 cm). The value of $|W|$ should be multiplied by the conversion factor to obtain expression (27). Thus, the electric model with parameters (28) can modulate the absorption of longitudinal wave in sandstone with frequency $\omega = 0.2$ and working frequency of the model $\omega = 500\ 000$. As an example, the computation is shown of the two series of parameters (29) of the electric model. Fig.1 represents the graphs of velocity of distribution (a), the coefficients and decrements of absorption (b) and wave resistance B as calculated from (14) to (17). The curves $R_n = 20$ kΩ represent the first series and $R_n = 3$ kΩ the second series. The curves represent the medium with elastic reaction with the parameters as shown in (30). The results of analysis show:

1) The minimum velocity of the distribution can be calculated from (31), whilst its maximum value can be calculated from (32). In the electric model the dispersion of velocities depends on the value of the condenser capacity C_n. When it is small (all the

Computation and Modeling of Absorption of Seismic Waves

elasticity K_n in the mechanical model is great) the dispersion of the velocity is small. This will occur when the ratio of β_0/λ_0 in (31) is small. The value of a frequency f_1 giving the smallest variation of velocity can be found from (8) and expressed as (33). For the first series of parameters f_1 = 24.5 kh and the second f_1 = 160 kh.

2) The coefficient of absorption increases with an increase of frequency to a certain value according to the expression (34).

3) The decrement of absorption also increases from zero at $\omega \to 0$ to maximum at (35) and decreases to zero from $\omega \to \infty$. The frequency of the first series is f_Δ = 53.2 kh and the second f_Δ = 355 kh. The maximum of decrement of absorption is calculated from (36), i.e. it does not depend on the resistance R_n and cannot be greater than 2π.

4) The relation of the module of wave resistance (17) to the frequency is shown in (37) at $\omega \to 0$ and (38) at $\omega \to \infty$. The argument Θ, describing the dislocation of

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Computation and **Modeling** of Absorption of Seismic Waves

phases can be found from (39) for $\omega \to 0$ with the frequency defined by (35). The angle Θ is always positive and never exceeds 45°.

5) For the limiting values of ω the velocity of distribution (31), (32) and the module of wave resistance (37), (38) become directly proportional to the parameters of medium, e.g. for $\omega \to 0$ the coefficient of elasticity is determined by (40) where $D = \beta_0/\lambda_0$, for $\omega \to \infty$ it increases with an increase of $K_{\omega \to \infty} = \lambda + 2\mu$. It could be compared with the electric model when $(C_0 + C_n)$ is used for $\omega \to 0$ and only C_0 for $\omega \to \infty$.

6) It can be said generally that as in the case of the relaxation theory of rubber, also in the theory of the medium with elastic reaction, it is possible to assume a sequence composed of a period of relaxations $1/\lambda_0$, 1, λ_{01}, $1/\lambda_{02}$, ... In the case of decrement of absorption existing the velocity of distribution becomes self explained.

The computation of visco-elastic medium and its electric model is performed in the same way as in the case

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Computation and Modeling of Absorption of Seismic Waves

of medium with elastic reaction. The value of q_o is found from (41), the coefficient of absorption α'_o from (42) and $|W|$ and Θ from (42a). As this kind of medium can be treated as a special case of elastic reaction, the formula (42) can be obtained from the expressions (5), (7), (10) and (12) by taking $\lambda + 2\mu \to \infty$. The relation of the parameters of medium to those of the electric model is calculated from (43), (44). Fig.2 represents the curves computed from (44) - a) velocity of distribution, b) coefficients and decrements of absorption and B) wave resistance of the parameters (45) and (46). It can be seen from the graphs that the velocity of distribution (47) increases from a minimum at $\omega = 0$ to infinity at $\omega \to \infty$. Therefore, the visco-elastic medium and its model have an abnormal distribution of velocities at every frequency. Also the coefficients of absorption and decrement $\alpha_o(\omega)$ and $\Delta(\omega)$ increase, reaching $\alpha_{max} \to \infty$ and $D_{max} = 2\pi$ at $\omega \to \infty$. The module and argument of wave resistance (48) and Θ behave similarly. Therefore, it can be stated generally that at the greater values of coefficient of elasticity η (or active resistance R_n in the model) the velocity of distribution, the coefficient of absorption and module of wave resistance increase with an increase of frequency ω.

The computations for the medium in a state of residual deformation, being a particular case of elastic reaction when $\lambda_0 = 0$, can be made from the formulae (5), (7), (10) and (12) in order to obtain (49). The formulae (50) for the electric model are obtained from (14) to (17). The medium parameters are related to those of the electric model as shown in (51). Fig.3 represents the curves of C, α_0, Δ, $|W|$ as calculated from (5) for the parameters (52) and (53). It can be seend from the graphs and from (49), (50) that the velocity of distribution increases directly from zero at $\omega = 0$ to a certain value (54) at $\omega \to \infty$. Therefore, an abnormal dispersion of velocity takes place at every frequency. Similarly, the coefficient of absorption increases to a value (55) when $\omega \to \infty$. The decrement of absorption decreases from its maximum value 2π to zero when $\omega \to \infty$. The module of wave resistance increases to the value (56) when $\omega \to \infty$, while the argument decreases from its maximum 45° to zero. It should be noted that at certain values of the frequency, the medium behaves as having an ideal elasticity - the parameters become independent from velocity with only slight absorption (55) taking place.

The experimentations were carried on with the electric models representing all three types of medium. The frequency was taken as (57) for the parameters L_o and C_o (58) for $R_n \rightarrow 0$. The results are shown in Fig.4 where seismograms are numbered I to VIII, representing -

I - the impulse obtained in the models;

II - model of ideal elastic medium;

III and IV - medium with elastic reaction at $R_n = 20\ k\Omega$ and $3\ k\Omega$ (the seismogram III shows the distribution of impulses in sandstone);

V and VI - model of visco-elastic medium at $R_n = 3\ k\Omega$ and $20\ k\Omega$;

VII and VIII - model of medium with residual deformation at $R_n = 20\ k\Omega$ and $82\ k\Omega$.

The results are tabulated. The left part of the table

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Computation and Modeling of Absorption of Seismic Waves

shows the theoretical values taken from the Figs.1-3. The equivalent data obtained from the experimentations is shown on the right. The coefficient of absorption was calculated from (59).
There are 4 figures, 1 table and 14 references, 13 of which are Soviet, 1 German.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki Zemli (Institute of Physics of the Earth, Ac. Sc. USSR)

SUBMITTED: April 18, 1957

Card 9/9

SOV/49-59-2-5/25

AUTHOR: Ivakin, B. N.

TITLE: Elastic Media with Non-Ideal Inertia and their Models (Uprugiye sredy s neideal'noy inertsionnost'yu i ikh modeli)

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya geofizicheskaya, 1959, Nr 2, pp 210-220 (USSR)

ABSTRACT: Absorption of elastic waves in solids is usually ascribed to non-ideal elasticity of the medium (Refs 1, 2). Such absorption may be also due to non-ideal inertia of masses involved. The masses with non-ideal inertia are those which can be represented by dampers and consequently they absorb elastic energy. As an example of a medium with non-ideal inertia of masses the author quotes granular seismic media impregnated with a liquid or a gas. Macroscopically such a medium can be regarded as uniform. A liquid or a gas which fills the pores of the medium represents additional elasticity or in ertia. The part played by such a liquid or a gas in the transmission of elastic vibrations is limited because at points of contact between grains the liquid or the gas would be pushed away from the contact. When the liquid or the gas is being pushed away it represents an elasto-viscous (non-ideally elastic), as well as inertio-viscous (non-ideally inertial) resistance. A good example of such

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Elastic Media with Non-Ideal Inertia and their Models

behaviour was dealt with by Frenkel' (Ref 5) who discussed filtration of liquids on propagation of elastic waves through a liquid-impregnated granular medium. In the first section of the present paper the author discusses media and their mechanical and electrical models on the assumption that they are ideally elastic and non-ideally inertial. The second part of the paper deals with the case of a non-ideally elastic and non-ideally inertial medium subjected to sinusoidal waves and possessing a Sokolov-Skryabin type after-effect. A medium with non-ideal elasticity differs from a medium with non-ideal inertia in its wave impedance. With increase of frequency, the modulus of the wave impedance of a medium with non-ideal elasticity always increases, while the corresponding modulus of a medium with non-ideal inertia always decreases. The argument of the wave impedance of a non-ideally elastic (elasto-viscous) medium is always positive, in contrast to a medium with non-ideal inertia (inertio-viscous) whose argument is always negative. Furthermore, the pressure wave (voltage in the electrical model) always leads the displacement wave (current in the electrical model) in an elasto-

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Elastic Media with Non-Ideal Inertia and their Models

viscous medium. The exact converse is true for an inertio-viscous medium. These differences may be used as criteria to separate out the elasto-viscous and inertio-viscous mechanisms of absorption in experimental verification of the theory of absorption of elastic waves in solids. The author points out that a medium whose elastic and inertial after-effect constants are equal, has a wave impedance independent of frequency, but it still exhibits dispersion of velocities. The paper is entirely theoretical. There are 7 Soviet references.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki Zemli (Academy of Sciences USSR, Institute of Physics of the Earth)

SUBMITTED: May 10, 1957.

Card 3/3

IVAKIN, B N

The Microstructure and Macrostructure of Elastic Waves in One-Dimensional Continous Nonhomogeneous Media. (Washington) American Geophysical Union; New York, Consultants Bureau (c1960)

113 p. Graphs (Soviet Research in Geophysics in English Translation, Vol. 3)

Translated from the Original Russian: Mikrostruktura I Makrostruktura Uprugikh Voln V Odomernykh Nepreryvnykh-Neodnorodnykh Sredakh. (Trudy Geofizicheskogo Instituta No. 39 (166) Moscow, 1957.

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S/049/60/000/008/005/015
E201/E191

AUTHOR: Ivakin, B.N.

TITLE: Methods of Controlling the Density and Elasticity of a Medium in Two-dimensional Modelling of Seismic Waves

PERIODICAL: Izvestiya Akademii nauk SSSR, Seriya geofizicheskaya, 1960, No. 8, pp. 1149-1167

TEXT: The author describes methods of varying the density and elasticity of thin sheets or plates used in two-dimensional modelling of seismic waves. Such variations could be produced by (1) a rectangular grid of holes in a sheet or of projections attached to the sheet, (2) using sheets of variable thickness, (3) using sheets stacked together along their large faces, for example by joining sheets of brass and Plexiglas or of aluminium and celluloid. The calculated results were compared with experimental values of the effective velocities of elastic waves obtained in 1958-59 in the Modelling Laboratory of the Physics of the Earth Institute, Academy of Sciences USSR. It was found that the method (3) was unsuitable. Most of the work was done using sheets with holes (apertures) or projections. In the case of

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Methods of Controlling the Density and Elasticity of a Medium in Two-dimensional Modelling of Seismic Waves

brass sheets the projections were attached by soldering brass pieces with Wood's alloy; the impedances for longitudinal waves were the same for brass and Wood's alloy. Some of these sheets with holes and projections are shown in Fig.1. Fig.2 illustrates a point in calculation of the effective elasticity of a sheet with circular holes. The effective velocities of longitudinal waves in sheets with circular or square holes or with square projections are given in Fig.3 and in a table on pages 1156-1157 (this table gives also the effective density of various types of sheets and the velocity of transverse waves). Seismograms obtained in a Duralumin sheet with circular holes are shown in Fig.4. Fig.5 gives the angular distribution of velocities for Duralumin sheets with circular holes or linear projections. The calculations and experiments led to the following conclusions. The wavelengths employed in sheets should satisfy the relationship $\lambda \geqslant (8-10)\ h_1$, where h_1 is the largest distance between two neighbouring holes or projections. Reduction of the effective velocity of elastic waves in sheets with holes

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may reach 40-60% of the velocity in a uniform sheet; projections can reduce the wave velocity only by 10-20%, since the height of the projections has to be limited. Using two sheets of different thickness stuck or soldered together along their edges (Fig.6) the effective density can be reduced or increased at the boundary between the sheets by a factor of up to three. Employing four materials, e.g. aluminium, steel, brass and Plexiglas, and joining sheets along their edges, it is possible to model seismic waves with velocities from 1300 to 5400 m/sec in media with densities from 0.5 to 15-18 g/cm^3. Sheets with holes or projections and with variable thickness can be used as models of anisotropic media, as well as of media with smoothly varying elastic properties. There are 6 figures, 1 table and 38 references: 24 Soviet, 10 English, 1 German and 3 Japanese.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki zemli (Physics of the Earth Institute, AS USSR)

SUBMITTED: December 30, 1959

Card 3/3

32220
S/139/61/000/004/010/023
E032/E314

24.5300

AUTHORS: Suyetin, P.Ye. and Ivakin, B.A.

TITLE: On the diffusion thermal effect

PERIODICAL: Izvestiya vysshikh uchebnykh zavedeniy, Fizika, no. 4, 1961, 87 - 91

TEXT: The diffusion process consists of the transport of both matter and heat. The transport of heat gives rise to a temperature gradient and a nonuniform heating of the diffusing mixture, even though the average temperature of the mixture remains constant. If the temperature gradients and the concentrations are small and the pressure gradient and macroscopic motion of the mixture can be neglected, the temperature and concentration distributions are described by the following linear equations:

$$\frac{\partial c}{\partial t} = D\left(\Delta c + \frac{K_T}{T}\Delta T\right) \qquad (1)$$

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and

$$\frac{\partial T}{\partial t} - \frac{K_T}{C_p}\left(\frac{\partial \mu}{\partial c}\right)_{P.T.} \frac{\partial c}{\partial t} = \chi \Delta T \qquad (2)$$

where c is the concentration, defined as the ratio of the mass of one of the components per unit volume to the total mass of the mixture per unit volume,
D is the diffusion coefficient,
T is the absolute temperature,
K_T is the thermal-diffusion ratio,
μ is the chemical potential,
χ is the temperature diffusivity, and
C_p is the specific heat at constant pressure.

If the diffusion-temperature gradient has a negligible effect on the mass transport, these equations reduce to:

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$$\frac{\partial c}{\partial t} = D\Delta c \tag{3}$$

and

$$\frac{\partial T}{\partial t} - \frac{K_T}{C_p}\left(\frac{\partial \mu}{\partial c}\right)_{P.T.}\frac{\partial c}{\partial t} = \chi\,\Delta T \tag{4}$$

The authors derive a solution of this set of equations subject to the following conditions. Two cylinders are filled with the mixture at the same pressure but the composition of the mixture in cylinder 1 is slightly different from that in cylinder 2 (Fig. 1). The diffusion process begins when the two cylinders are made coaxial. It is assumed that the initial concentration of the lighter component in the mixture in the lower cylinder is $c_o + \delta c_o$, while the concentration in the upper cylinder is $c_o - \delta c_o$. The initial temperature in both cylinders is T_o. It is shown that the final solution for the temperature difference $\Delta T = T - T_o$ is of the form:

$$\Delta T(y,t) = \frac{\alpha P \delta N_o D}{\lambda - c_p \rho D}\left[\operatorname{erf}\left(\frac{y}{\sqrt{2Dt}}\right) - \operatorname{erf}\left(\frac{y}{\sqrt{2\chi t}}\right)\right] \qquad (12)$$

[Abstracter's note: not all the symbols are explicitly defined.]

Fig. 2 shows a graph of ΔT_o as a function of time (seconds) for Ar-He with $T_o = 285\ ^\circ K$, $P = 740$ mm, $N_o = 0.20$, $\delta N_o = 0.10$ and $y = 4$ cm. This curve was calculated from Eq. (12). The authors have measured the diffusion thermal effect, using the apparatus described in a previous paper (Ref. 2 - the authors and their team - ZhTF, 29, no. 8, 1058, 1959). It

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On the diffusion thermal effect

was found that the thermal-diffusion constant decreased from 0.3 to 0.2 when the concentration of the heavier component of the mixture increased from 0.20 to 0.8.
There are 4 figures and 4 references: 3 Soviet-bloc (one of which is a translation from a non)Soviet-bloc publication) and 1 non-Soviet-bloc. The English-language reference mentioned is: Ref. 1; J.O. Hirschfelder, G.F. Curtiss, R.B. Bird, Molecular theory of gases and liquids, New York, 1954.

ASSOCIATION: Ural'skiy politekhnicheskiy institut imeni S.M. Kirova (Ural' Polytechnical Institute imeni S.M. Kirov)

SUBMITTED: June 1, 1960

Card 5/6 5

24,1800 (1063,1144)
9,6180 (1137)

29576
S/049/61/000/005/009/013
D201/D306

AUTHORS: Ivakin, B.N., and Vasil!yev, Yu. F.

TITLE: Capacitive receivers of ultrasonic pulses

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya geofizicheskaya, no. 5, 1961, 725-729

TEXT: The authors describe and give the results of experimental investigations into the performance of a receiver designed to find a wider band registration of ultrasonic oscillation.The receiver, based on the effect of capacitance changes as a function of the change in spacing of two parallel plates, was suggested by B. N. Ivakin and designed at the Laboratoriya modelirovaniya instituta fiziki zemli AN SSSR (Laboratory of Simulation of the Institute of Physics of the Earth, AS USSR). Fundamentally the receiver consists of a steel rod as the measuring electrode of the capacitor, there being a layer of dielectric between the rod and the vibrating source. The acoustic theory of the device by B.N. Ivakin (Ref. 5: Tr. Geofiz. in-ta AN SSSR, no. 39, 1958). Using Equations (158) X

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from this work modified to suit the given conditions (the dielectric layer is much thinner than the wavelength), the amplitude δ_u and the phase characteristic β_u of displacement u_{x_1} and u_{x_2} of the electrode capacitor planes are given by

$$\delta_u = \frac{u_{x_1} - u_{x_2}}{u_{x_1}} = \frac{\sqrt{1 + n_{12}^2 \sin^2 af} - 1}{\sqrt{1 + n_{12}^2 \sin^2 af}} \quad (1)$$

$$\beta_u = \text{arctg}\,(n_{12}\ \text{tg}\ af) \quad (2)$$

where $n_{12} = W_1/W_2$ - the ratio of acoustic characteristic impedances of the steel rod and of the dielectric f - frequency, $a=2\pi\frac{l_o}{c_2}$, l_o being the thickness of dielectric and c_2 - the velocity of sound propagation in it. The quantity δ_u may be called the displacement utilization factor since it is actually the measure of transformation of displacements into the relative displacement of the capacitor electrodes. The amplitude and frequency response evaluated from (1) and (2) for the air and capacitor paper gap show the wide frequency band properties of the probe. The registration of the capacitance change is achieved either by amplification of the varying voltage across the condenser (constant charge applied) or by using the capacitance change for changing the frequency of a HF generator. In the first case (LF registration method) the variable capacitor constitutes the input of a cathode follower. Using a 6С1П (6S1P) triode, the d.c. voltage is applied to the variable condenser at the input through the resistor R_H X connected to the HT rail. For undisturbed registration of electrode displacements the required condition is that the time constant $R_H C_{dis} = \tau$ is much greater than the period of registered oscillations. The sensitivity of this amplifier is proportional to δ_u and to the d.c. voltage V, across the variable capacitor and inversely proportional to the spacing between the electrodes l_o. To determine the greatest sensitivity various acoustic materials were tested for filling it besides air: condenser paper, impregnated cloth, cellophane, nylon, rubber, glue films (БФ-2, ГЭН-150,88 (BF-2, GEN-150, 88)). The gap was made as small as possible: i.e. l_o = 5 - 50 microns. The best sensitivity was obtained with the condenser paper. The gap with a thin coating of rubber (5 - 10 microns) provided most sensitivity, but made the instrument unstable in operation. When comparing the registered waveforms with those obtained with the same conditions by the wide-band barium-titanate receiver as designed by L. N. Rykunov, it was seen that the latter was actually differentiating the registered pulse and

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might be considered primarily as a pressure transcender, while the capacitive receiver produces a non-differentiated pulse and is a true displacement transcender. In an attempt to determine approximately the absolute displacement measurements, the capacitive receiver was compared with a Seignette's salt receiver having a sensitivity of 0.5 microvolt/bar and the results obtained can be assumed to be in good enough agreement. In the HF variant of the capacitive receiver, the capacitive probe was used as the tuning capacitor in a Clapp oscillator in a circuit described by H. M. Sharat (Ref. 7: Noncontacting gage for microdisplacement. Electronics, 27, no. 6, 1954). Although the results obtained show that the device is much more sensitive in this arrangement, its applications are limited because of the complicated circuitry involved. There are 5 figures and 7 references: 4 Soviet-bloc and 4 non-Soviet-bloc. The references to the English-language publications read as follows: J. E. Evans, C. F. Hadley, J. D. Eisler, D. Silverman. A three-dimensional seismic wave model with both electrical and visual observation of waves. Geophys., 19, no. 2, 1954 (RZh Fiz., ref. no. 8232, no. 4, 1955); H. M. Sharat. Noncontacting X

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D201/D306

Capacitive receivers of ...

gage for microdisplacement. Electronics, 27, no. 6, 1954.

ASSOCIATION: Akademiya nauk SSSR, Institut fiziki zemli (Academy of Sciences USSR, Institute of Physics of the Earth)

SUBMITTED: September 13, 1960

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Card 6/6

AUTHORS: Ivakin, B. N., and Vasil'yev, Yu. I. S/049/63/000/002/003/008 D207/D307

TITLE: Wave properties of perforated sheets in seismic modeling

PERIODICAL: Akademiya nauk SSSR. Izvestiya. Seriya geofizicheskaya, no. 2, 1963, 248-260

TEXT: Velocities and the energy absorption were determined for elastic waves propagated in perforated Duralumin sheets (1 - 2 mm thick) with a uniform distribution of circular holes (2 - 4 mm diameter) along an equilateral triangular grid. The results (seismograms and hodographs) show that such sheets can be conveniently used for modeling seismic wave patterns because of (1) a wide range of longitudinal and transverse wave velocities and damping decrements obtainable by varying the hole diameter, (2) the absence of dispersion and anistropy of the velocities, (3) relatively short distance from the wave source

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S/049/63/000/002/003/008
D207/D307

Wave properties of...

required to obtain steady-state waves. There are 11 figures and 2 tables.

ASSOCIATION: Institut fiziki Zemli AN SSSR (Institute of Physics of the Earth, AS USSR)

[illegible] [illegible] 1962

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L 10740-63 EWT(1)/BDS—AFFTC/ESD-3—TF

ACCESSION NR: AP3002028 S/0049/63/000/006/0889/0906

AUTHOR: Ivakin, B. N.; Aver'yanov, A. G.

TITLE: Seismic wave modeling with two-dimensional perforated models in layered nonhomogeneous media

SOURCE: AN SSSR. Izv. Ser. geofizicheskaya, no. 6, 1963, 889-906

TOPIC TAGS: seismic modeling, two-dimensional perforated model, seismic wave propagation

ABSTRACT: Experiments in seismic wave modeling have been carried out on two-dimensional perforated models of nonhomogeneous, layered-homogeneous, and layered-nonhomogeneous media. Two-dimensional models for nonhomogeneous media were designed on the basis of the experimentally derived relationship between wave velocity and the diameter of the holes cut in a 2-mm duralumin sheet forming a triangular grid. In modeling a homogeneous half-space it was found that the divergence function index n for a direct longitudinal wave P varied between 0.5 and 1.5 when source and receiver were located on a free surface; in the three-dimensional model this would correspond to a variation of n from 1 to 2. The

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ACCESSION NR: AP3002028

attenuation patterns of head and refracted waves varied; the head waves showed rapid attenuation, and the refracted waves attenuated rather slowly with increasing distance even at small velocity gradients. To overcome the low resolution of waves caused by long-period oscillations, it is suggested that wide-band transducers be developed which would produce a pulse ranging from 2 to 10 microseconds. Orig. art. has: 16 figures, 4 tables, and 8 formulas.

ASSOCIATION: Akademiya nauk SSSR. Institut fiziki Zemli (Academy of Sciences SSSR. Institute of Physics of the Earth)

SUBMITTED: 07Aug62 DATE ACQ: 16Jul63 ENCL: 00

SUB CODE: 00 NO REF SOV: 011 OTHER: 000

Card 2/2

ACC NR: AT6032727 SOURCE CODE: UR/0000/66/000/000/0009/0018

AUTHOR: Ivakin, B. N. (Candidate of physico-mathematical sciences)

ORG: none

TITLE: Development of methods of modeling seismic ves

SOURCE: AN SSSR. Institut fiziki Zemli. Geoakustika; ispol'zovaniye zvuka i ul'trazvuka v seysmologii, seysmorazvedke i gornom dele (Geoacoustics; the use of sound and ultrasound in seismology, seismic prospecting, and mining). Moscow, Izd-vo Nauka, 1966, 9-18

TOPIC TAGS: seismic wave, seismic modeling, elastic wave, Poisson coefficient, upper mantle

ABSTRACT:
Laboratory investigations of elastic-wave phenomena in the USSR began in the 1920's, and, to a considerable extent the progress coincided with advances in radio and electrical engineering. Early work on seismic-wave modeling was conducted in the Institute of Physics of the Earth of the Academy of Sciences USSR and employed mechanical grid models, which, though unwieldy and unsophisticated, proved useful in understanding the physics of wave propagation in thin heterogeneous media. Early research by Soviet scientists on laboratory investigations of elastic-wave phenomena was summarized by S. I. Krechmer and S. N. Rzhevkin in [Usp. fiz. nauk, 18, 1, 1937].

UDC: [534.3/.4+(534.8)]:(550.34+622)

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ACC NR: AT6032727

Experiments with ultrasonic seismic-wave modeling were begun in the Modeling Laboratory in 1947. By 1950 a seismoscope had been developed, with which the first results were obtained in investigating seismic waves in liquid models with solid layers to simulate geological layers. Seismic modeling became more widespread with the introduction of the UZS-2 unit. Ultrasonic seismic-wave modeling received further impetus in 1956 with the publication of B. N. Ivakin's [Izv. AN SSSR, seriya geofiz., no. 11, 12, 1956] theory of wave phenomena similarity which showed that the Poisson's coefficients in the model had to be equal to the corresponding points in nature. It was also shown that two types of models could be used, viz., those in which the velocities and densities were kept the same in the corresponding layers in the model and in nature, and those in which the model velocities and densities differed from those in nature. The second type made it possible to use different modeling materials, provided the Poisson coefficients were the same in the model as in nature. Ivakin's theory of wave similarity was found to be valid for all layered homogeneous media, but invalid for gradient media.

Some of the studies performed and results obtained using the early

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ACC NR: AT6032727

liquid models with solid layers were as follows: 1) the transmission and screening of elastic waves in a solid thin layer was investigated, 2) graphs showing the passage transmission coefficient as a function of the angle of incidence were obtained, 3) the changes in the shape of a head wave as a function of the thickness of the layer were investigated, 4) the screening properties of a thin layer and of a series of thin layers were determined, and 5) the wave patterns of the waves transmitted through a single layer and a series of layers whose total thickness was the same as the single layer were compared.

Since these early efforts, the tempo and range of research have increased considerably. Thus, for example, N. I. Davydova [Izv. AN SSSR, seriya geofiz., no. 5, 1959] has obtained interesting results in her investigations of head waves in thin layers and the dependence of the diffraction of shock waves incident at the critical angle on the layer angle. Yu. V. Riznichenko and O. G. Shamina [Izv. AN SSSR, seriya geofiz., no. 12, 1960] have investigated scattered waves in a series of layers (water-iron or water-glass) in a work of special importance to seismic prospecting. Yu. N. Voskresenskiy [Izv. AN SSSR, seriya geofiz., no. 5, 1962] has studied the reflecting properties of nonmirror-like boundaries in three-dimensional liquid

ACC NR: AT6032727

models in connection with the development of the RNP [controlled directional reception] method. Yu. V. Timoshin [Kand. dissertatsiya. L'vovskiy Politekhn. in-t, L'vov, 1954] has made model studies of the behavior of reflected waves in media with curvilinear boundaries, and S. A. Fedotov [Trudy Geofiz. in-ta AN SSSR, no. 35, 1956] developed an approximate method of computing the dynamic travel-time curves of waves refracted by such boundaries. Fedotov also examined the focusing properties of curvilinear boundaries.

Diffracted waves have been investigated by a number of scientists. O. I. Rogoza [Prikladnaya geofizika, vyp. 29, 1961] studied the diffraction of waves from the corner of a cement block placed in water. T'eng Chi-wen [Kand. dissertatsiya. Fondy IFZ AN SSSR, 1962] made a detailed study of the diffraction of waves in different types of faults. T'eng obtained the first results on the frequency dependence of diffracted waves with the aid of a seismic spectroscope developed by V. A. Obukhov [Izv. AN SSSR, seriya geofiz., no. 10, 1961]. V. V. Kun [Izv. AN SSSR, seriya geofiz., no. 12, 1960] studied the effects of pinchouts (wedges) and vertical interfaces on wave dynamics.

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In the field of marine seismic studies B. A. Osipova [Uch. zap. Azerb. un-ta, geologo-geograf. seriya, no. 5, 1959] made investigations of reverberation phenomena, while A. N. Barkhatov [Akust. zh., 1, vyp. 2, 1955] studied wave propagation in low-gradient media in liquid models.

With the introduction of two-dimensional modeling in 1952 Yu. V. Riznichenko, B. N. Ivakin, and V. R. Bugrova [Izv. AN SSSR, seriya geofiz., no. 3, 1952] studied the Lamb problem and recorded longitudinal and Rayleigh waves along the model surface. No shear waves were observed in these experiments. Subsequent experiments of Riznichenko and Shamina [Izv. AN SSSR, seriya geofiz., no. 3, 1959] showed that a wave, considered to be a pure head wave, was in fact an interference wave consisting of a head wave and a wave reflected at an angle greater than the critical angle. This interference of head and reflected waves leads to a decrease in the effective value of the coefficient of dispersion from a layer of finite thickness. Shamina and O. I. Silayeva [Izv. AN SSSR, seriya geofiz., no. 3, 1958] investigated the wave properties of plates of finite thicknesses for the purpose of standardizing the selection of plate thicknesses in two-dimensional modeling.

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They investigated wave velocities in the plate, pulse attenuation with distance, and the nature of wave propagation.

M. B. Rappoport and Yu. N. Voskresenskiy [Izv. AN SSSR, seriya geofiz., no. 2, 1961] have investigated waves reflected from rough surfaces in connection with the further development of the RNP method. The latter investigator, using perforated modeling techniques, constructed a model with which, for the first time, the physical boundary roughness rather than the geometrical roughness was examined. V. V. Khorosheva [Izv. AN SSSR, seriya geofiz., no. 8, 1962] has investigated the properties of a low-velocity layer with sharp boundaries, simulating the subcrustal low-velocity channel.

Perforated-sheet modeling has been developed in the Soviet Union by Yu. F. Vasil'yev, P. G. Gil'bershteyn, I. I. Gurvich, and B. N. Ivakin [Izv. Vyssh. uchebn. zaved., geolog. i razvedka, no. 1, 1960; Izv. AN SSSR, seriya geofiz., no. 8, 1960; Izv. Vyssh. uchebn. zaved., geolog. i razvedka, no. 5, 11, 1962; Izv. AN SSSR, seriya geofiz., no. 2, 1963]. To date only approximate theoretical investigations of the propagation velocities of those elastic waves which are much longer than the distance between perforations have been carried out. To some degree this shortcoming has been overcome by experimental parametric investigations.

In 1963 using perforated models, Gil'bershteyn and Gurvich obtained important results with respect to head waves and waves along the interface in thin layers of a solid medium. They have recorded head waves for thin layers for the case in which theory, as A. A. Molotkov and P. V. Krauklis [Izv. AN SSSR, seriya geofiz., no. 6, 1963] assert, would preclude their existence. This very important question for seismic exploration still awaits final solution.

Again with perforated models, A. G. Aver'yanov and B. N. Ivakin [Izv. AN SSSR, seriya geofiz., no. 6, 1963] investigated multiply refracted and diffracted waves in layered heterogeneous seismic media having a structure similar to that of the earth's crust. The results agreed with the theoretical computations of such media by the ray method developed by the research group of G. P. Petrashen'.

Lack of an exact theory for bimorphic models, proposed in the

United States by J. Oliver and successfully used in the USSR by Yu. V. Riznichenko, O. G. Shamina, and R. V. Khanutina [Izv. AN SSSR, seriya geofiz., no. 4, 1961], prompted these last named Soviet scientists to conduct special experiments to investigate generalized or bimorphic waves which made it possible to define the most favorable conditions for bimorphic modeling. As a result of these studies, absorption coefficients were determined for bimorphic models; it was shown that the effect of converting symmetrical oscillations to antisymmetrical oscillations does not lead to any noticeable additional absorption of longitudinal waves. Finally, methods of preparing bimorphic models were worked out.

Using bimorphic models Riznichenko and Shamina [Izv. AN SSSR, seriya geofiz., no. 2, 1963] studied the wave properties of the upper mantle of the earth. In these experiments three mantle types were investigated: 1) the Jeffrey's model, (velocity increases with depth), 2) the Guttenberg model (velocity decreases with depth), and 3) a homogeneous model.

L. N. Rykunov, V. V. Khorosheva, and V. V. Sedov [Izv. AN SSSR, seriya geofiz., no. 11, 1960] have been working on the

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development of a thermal method of controlling the elastic properties of two-dimensional models. These investigators have created a low-velocity channel and have determined its effect on wave propagation by comparing this model with a homogeneous model. The thermal model is relatively simple, and the same model can repeatedly reproduce different structural features of heterogeneous models.

Control of the density properties of models by means of varying their thicknesses was theoretically developed by Ivakin [Izv. AN SSSR, seriya geofiz., no. 8, 1960]. Use of this method is temporarily hindered by the difficulty of preparing sheets with an uneven cross section.

Seismic-wave modeling in three-dimensional solid models is also being practiced. In modeling diffracted waves from the core of the earth, L. N. Rykunov [Izv. AN SSSR, seriya geofiz., no. 5, 1959] used a three-dimensional model of the earth consisting of a thin-walled sphere made of a paraffin polyethylene alloy (mantle) filled with water or a gelatin solution (core). Estimates obtained from such models on the rigidity of the core were close to those arrived at by M. S. Molodenskiy.

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S. F. Bol'shikh, V. P. Gorbatova, and L. N. Davydova [Prikl. geofiz., vyp. 30, 1961] have described three-dimensional gradient models made of cement and sand mixed in varying proportions. They have also examined the ratio of intensities between reflected and head waves in layered media models.

I. A. Viktorov [Dokl. AN SSSR, 119, no. 3, 1958] investigated the transmission of R-waves in a duralum model in the case of a surface with fissure and wedge defects. The operating frequency in this experiment was 3 mc and the duration of the signal pulse was 10 μsec. He also determined the dependence of the reflection and transmission coefficients on the size of the surface indentations. I. A. Viktorov in [Akust. zh., 7, no. 1, 1961] investigated the attenuation of R-waves on cylindrical surfaces and discovered additional attenuation in the case of propagation on concave surfaces associated with the curvature. No attenuation was observed in the case of convex surfaces. In still another work [Akustich. zh., 7, no. 1, 1961] he examined the transmission and reflection of R-waves on curved surfaces with various radii. In recording transmission coefficients as the radius of curvature at the intersection of two perpendicular planes, he observed that the coefficient does not change monotonically but in

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jumps. N. N. Yegorov [Sb. Primeneniye ul'traakustiki k issledovaniyu veshchestva, vyp. 15, 1961] used impulsive sources in investigating the attenuation of Rayleigh waves in an elastic medium at frequencies of 0.8—18 mc.

As is evident, three-dimensional solid models are still not very helpful in the study of body waves, although they are useful in studying surface waves with frequencies of about 1 mc and higher. It would be interesting to investigate body waves in three-dimensional solid models using higher frequencies (about 1—3 mc) if the size of the model were suitable for laboratory experiments. In the USSR at present, micromodeling techniques of body seismic waves at frequencies of 1—5 mc are being developed for use under laboratory conditions.

The first attempt in the Soviet Union to model an earthquake focus with the aid of a piezoelectric transducer was made by V. I. Ulomov [Izv. AN SSSR, seriya geofiz., no. 2, 1961] in his study of the distribution of signs of first arrival of longitudinal waves on the surface of a three-dimensional model.

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B. N. Ivakin [Izv. AN SSSR, seriya geofiz., no. 7, 1958; Izv. AN SSSR, seriya geofiz., no. 11, 1958; Izv. AN SSSR, seriya geofiz., no. 2, 1959] has shown the possibility of modeling the absorbing properties of a real seismic medium in simple electrical one-dimensional grids. The wave processes in such grids are described by equations of motion analogous to the equations for the elastic media.

Electrical models and especially their mechanical analogs are quite useful in revealing the phenomenological side of absorption and are helpful in improving the correspondence between the model and the actual absorbing medium. In this way, for example, a completely new absorption mechanism associated not with nonideal elasticity but with the nonideal inertia of the mass of the absorbing medium was revealed. This phenomenon was later explained in experiments conducted by V. S. Nesterov [Akust. zh., 5, vyp. 3, 1959].

Model work at present is aided by improved apparatus, especially seismoscopes. Obukhov's development of an instrument for the frequency analysis of ultrasonic waves in modeling has made possible

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considerable qualitative advance in seismic-wave modeling. Further advances in ultrasonic modeling have been retarded by the inadequacy of exiting sensors. To overcome this, research has proceeded in several directions. For example, L. N. Rykunov and V. D. Feofilaktov [Izv. AN SSSR, seriya geofiz., no. 2, 1961] have proposed a piezoelectric emitter of single-stroke pulses, which, in the case of broadband reception, significantly increased the wave resolution in the model. However, this method is not always effective at the higher frequencies. By mechanical damping of the piezoelectric transducers, V. P. Telezhenko and Yu. V. Gorshenin [Trudy SNIIGGIMS, vyp. 7, 1961] obtained ultrasonic bell-shaped pulses, at the expense of a loss in sensitivity. The broadband piezoelectric receiver developed by G. A. Grechishnikov and V. P. Nomokonov [Geoakustika, Moskva, Izd-vo "Nauka," 1966, p. 62] is made of a stack of crystals of Rochelle salt of uneven height enclosed in an absorbing shell. Stable acoustic contact was ensured by the use of vaseline. Ivakin and Yu. V. Vasil'yev [Izv. AN SSSR, seriya geofiz., no. 5, 1961] have designed a relatively simple volumetric receiver that promises to lead to the development of a two-component broadband receiver.

In seismic modeling it is absolutely essential to develop

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ACC NR: AT6032727

optical methods of visualizing waves, by using methods such as photoelasticity. In the GDR, H. Vosahlo [Photographische Korrespondenz, Wien, 97, N 1, 1961] has developed an optical system that makes possible a graphic representation in slow motion of the propagation of longitudinal and shear waves in several types of seismic models. It will make visible the process whereby various objects, including even the ordinary piezoelectric receiver, distort the wave field. This qualitative method of wave analysis is a good supplement to the oscillographic method.

Thus, considerable effort is being expended to overcome shortcomings in instrumentation. It is hoped that eventually modeling techniques will be as fruitful in investigating wave-propagation phenomena as theoretical approaches have been in the past. /FSB: v. 2, no. 11/

SUB CODE: 08 / SUBM DATE: 28Mar66 / ORIG REF: 046 / OTH REF: 020

Card 14/14

L 47138-66 EWT(1) GD/GW

ACC NR: AT6031368 SOURCE CODE: UR/0000/66/000/000/0034/0041

AUTHOR: Vasil'yev, Yu. F.; Gil'bershteyn, P. G.; Gurvich, I. I.; Ivakin, B. N. 31 B+1

ORG: none

TITLE: Perforated materials for two-dimensional seismic modeling

SOURCE: AN SSSR. Institut fiziki Zemli. Geoakustika; ispol'zovaniye zvuka i ul'trazvuka v seysmologii, seysmorazvedke i gornom dele (Geoacoustics; the use of sound and ultrasound in seismology, seismic prospecting, and mining). Moscow, Izd-vo Nauka, 1966, 34-41

TOPIC TAGS: seismic modeling, perforated material, seismic wave, ~~model~~, elastic wave, ~~propagation~~ wave propagation

ABSTRACT: A description is given of the use of perforated materials for controlling density and elasticity in ultrasonic seismic-wave modeling experiments conducted in the Institute of Physics of the Earth of the Academy of Sciences USSR and the Moscow Geological Prospecting Institute. Parametric measurements were made on two-dimensional sheets of duralum, brass, iron, and plexiglass containing perforations (d = 1—10 mm) arranged in triangular, hexagonal, and rectangular grids. The ratio of the dominant wavelength to the distance (which ranged from 2.5 to 20 mm) between the perforations varied from 4 to 50 depending upon the type of sheet and the nature of the experiment. Experiments were conducted to establish: 1) the possibility of recording regular

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longitudinal and shear waves, 2) the relationship between the effective elastic-wave propagation velocities and the size, number, and shape of the perforations, 3) the dispersion velocities, 4) the absorption of the elastic-wave energy, and 5) the possible appearance of velocity anisotropy and absorption in sheets with different perforation patterns. The results of experiments showed that under certain conditions regular longitudinal, shear, and surface waves arise in perforated materials and propagate with characteristic velocities almost without dispersion or attenuation as determined by the coefficient of effective absorption. Thus, perforated materials under specific conditions behave like a macrohomogeneous, nonideal, elastic medium to which can be imparted isotropic, anisotropic, or smoothly changing properties. The applicability of these materials in seismic modeling is determined by the appropriateness of the elastic, density, and absorbing properties of the rock to the analogous parameters, which can be controlled in perforated sheets by changing the perforation pattern. The accuracy of reproducing properties in these models is very high, reaching 1—2% in the case of velocity. Orig. art. has: 4 figures. [DM]

SUB CODE: 08/ SUBM DATE: 28Mar66/ ORIG REF: 007/ ATD PRESS: 5088

ACC NR: AT6032736

SOURCE CODE: UR/0000/66/000/000/0099/0102

AUTHOR: Ivakin, B. N. (Candidate of physico-mathematical sciences)

ORG: none

TITLE: The cause of lower-than-average velocity of wave propagation in thin heterogeneous media

SOURCE: AN SSSR. Institut fiziki Zemli. Geoakustika; ispol'zovaniye zvuka i ul'trazvuka v seysmologii, seysmorazvedke i gornom dele (Geoacoustics; the use of sound and ultrasound in seismology, seismic prospecting, and mining). Moscow, Izd-vo Nauka, 1966, 99-102

TOPIC TAGS: seismic modeling, elastic wave, refracted wave, reflected wave, layered medium, multiple reflection, WAVE PROPAGATION

ABSTRACT: The present paper deals with determination of the average velocity of elastic waves propagated perpendicular to the interfaces of a layered medium. Analysis of theoretical and experimental seismic modeling data indicates that the velocity of elastic waves in thin layered and in general in thin heterogeneous media determined from the formula for the average velocity in geometrical approximation is greater than the actual velocity. The possibility of refining this formula is analyzed. The decrease in the propagation velocity of wave energy in heterogeneous layers of thin layered media, when the wavelength is much greater than the thickness of the layers, is attributed to the mutual interaction (interference) of

ACC NR: AT6032736

(direct) refracted and reflected waves which always exists in the medium. If the reflected waves could be eliminated, the propagation velocity determined from the formula for the average velocity would give the correct value; however, owing to the multiple reflections at the interfaces, the wave amplitude in this case would decrease sharply with distance. The decrease in velocity in the media discussed is thus attributed to interference and not, as previously, to multiple reflections. Orig. art. has: 5 formulas and 1 figure.

SUB CODE: 08/ SUBM DATE: 28Mar66/ ORIG REF: 004/

IVAKIN, B.P.

Four blade carding beater. Tekst.prom. 20 no.7:65 Jl '60. (MIRA 13:7)

(Carding machines)

ZOT'YEV, A.I., kand.tekhn.nauk, red.; BOL'SHAKOV, G.P., inzh., red.; VYATKIN, V.P., kand.tekhn.nauk, red.; VASIL'YEV, N.N., inzh., red.; YEREMKIN, A. P., inzh., red.; IVAKIN, I.Ya., inzh., red.; MATVEYEV, I.B., kand.tekhn. nauk, red.; MAR'YANCHIK, M.A., inzh., red.; NOVICHKOV, P.V., inzh., red.; PEREVOZCHIKOV, B.S., inzh., red.; PODREZ, S.A., inzh., red.; RUBNENKOVA, L.V., red.; UKHANOV, V.N., red.; CHUDAKOV, P.D., kand.tekhn.nauk, red.; STEPANCHENKO, N.S., red.izd-va; SOKOLOVA, T.F., tekhn.red.

[Investigation and design of drop forging and die stamping machinery] Issledovaniia i raschety mashin kuznechno-shtampovochnogo proizvodstva. Pod red. A.I.Zot'eva. Moskva, Gos.nauchno-tekhn.izd-vo mashinostroit. lit-ry. Vol.1. 1959. 233 p. (MIRA 13:4)

1. Eksperimental'nyy nauchno-issledovatel'skiy institut kuznechno-pressovogo mashinostroyeniya.

(Forging machinery)

L 24813-66 EWT(d)/EWP(v)/EWP(k)/EWP(h)/EWP(1)

ACC NR: AP6007661 (A) SOURCE CODE: UR/0413/66/000/003/0030/0030

AUTHORS: Rikveyl', V. V.; Ivakin, B. V.

23
B

ORG: none

TITLE: Automatic regulator for lever brake transmission in railway rolling stock. Class 20, No. 178398 [announced by Riga Railcar Building Plant (Rizhskiy vagonostroitel'nyy zavod)]

14

SOURCE: Izobreteniya, promyshlennyye obraztsy, tovarnyye znaki, no. 3, 1966, 30

TOPIC TAGS: brake, railway rolling stock, ~~[crossed out]~~, railway equipment, automatic control equipment

ABSTRACT: This Author Certificate describes an automatic regulator for lever brake transmission in railway rolling stock. The regulator is constructed in the form of a chamber fastened to the frame of the car. The chamber contains a threaded rod and a regulating nut. The rod is connected to the regulating mechanism via a ratchet mechanism. To protect the regulator from damage (during braking), the bracing surfaces of the regulating nut and chamber are given a spherical form. This insures free movement of the threaded rod when it changes its position (see Fig. 1).

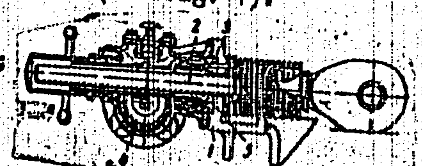

Fig. 1. 1 - chamber; 2 - threaded rod; 3 - regulating nut; 4 - regulating mechanism; 5 - bracing surface.

Orig. art. has: 1 figure.

SUB CODE: 13/ SUBM DATE: 03Aug64

UDC: 625.2-597.8

Card 1/1

S/182/61/000/009/003/005
D038/D112

AUTHORS: Ivakin, I.Ya. and Korolev, A.I.

TITLE: V-shaped inserts increase the durability of cold heading tools

PERIODICAL: Kuznechno-shtampovochnoye proizvodstvo, no. 9, 1961, 14-16

TEXT: The authors state that by using the construction principle of a V-shaped insert, described by R.V. Mil'vitskiy (Ref. 1: O raschete tolsto-stennykh tsilindricheskikh sosudov [On the calculation of thick-walled cylindrical vessels], "Khimicheskoye mashinostroyeniye", no. 1 (31), 1938), and by M.G. Gonikberg, D.S. Tsiklis and A.A. Opekunov (Ref. 2: K voprosu ob uprochnenii sosudov vysokogo davleniya [Contribution to the problem of reinforcing high-pressure vessels], Doklady Akademii nauk SSSR, t. 129, no. 1, 1959), it was possible to design reliable and durable equipment for the cold heading of metalware, i.e. 10-12 mm diam. bolts. Hard alloy or high-quality chilled steel inserts consisting of separate ground-in wedges were pressed in to the rim of the die or punch. The new design completely eliminated the tensile and annular stress effect since the radial and
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axial stresses remained compressive, so that the insert material exercised an all-round compression in the working zone. The use of a double-rim is recommended for the cold-heading of hexagonal-head nuts and bolts and other products when high-specific pressures are required. The authors conclude that: (1) by using the principle of a wedge vessel, it is possible to design reliable and durable equipment in which normal pressure in the working zone reaches 200,000 atm. (2) The use of the V-shaped inserts in cold heading of metalware increases the durability of dies and punches as the insert material exercises an all around compression in the most stressed zone of the die. (3) V-shaped inserts prove most economical for cold heading hexagonal head bolts and similar articles. (4) Chilled tool steel, instead of the costly tungsten and cobalt hard alloys, can be extensively used for the manufacture of the V-shaped inserts. There are 4 figures and 2 Soviet references.

IVAKIN, P.P.

122-2-9/23

AUTHOR: Bakhmutov, A.A., and Ivakin, P.P., Engineers.

TITLE: The plastic straightening of propeller shafts in turning (Plasticheskaya pravka grebnykh valov pri tokarnoy obrabotke)

PERIODICAL: "Vestnik Mashinostroyeniya" (Engineering Journal), 1957, No.2, pp. 51 - 54 (U.S.S.R.)

ABSTRACT: Bending deflection in ships' propeller shafts under the influence of built-in stresses is discussed. The relations between stresses and deflections are stated. A rational method of plastic straightening by mounting between centres in a lathe and applying progressive straightening deflections by a jack for several hours is presented. Artificial ageing is recommended.
There are 1 illustration and 2 tables.

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AVAILABLE: Library of Congress

IVAKIN, R.I.

Operation of pug mills. Lit. proizv. no.7:20-21 Jl '63.
(MIRA 17:1)

IVAKIN, R.I., inzh.

Elements in the theory of mixing molding materials. Lit. proizv. no.9:32-33 S '65. (MIRA 18:10)

GRUDININ, A.A.; IVAKIN, V.A.

Apparatus for determining the coal content in raw meal. TSement 29 no.6:19-20 N-D '63. (MIRA 17:3)

1. TSementnyy zavod "Pobeda Oktyabrya", Novorossiysk.

IVAKIN, V.A., inzh.; GRUDININ, A.A., inzh.

Unit for loading packaged cement in cars. TSement 30 no.3:
20 My-Je '64. (MIRA 17:11)

1. TSementnyy zavod "Pobeda Oktyabrya".

S/115/63/000/003/004/010
E194/E455

AUTHOR: Ivakin, V.M.

TITLE: A transistorized quartz clock

PERIODICAL: Izmeritel'naya tekhnika, no.3, 1963, 24-25

TEXT: A transistorized quartz clock has been made in the Nikolayevskoye otdeleniye GAO AN SSSR (Nikolayev Division of GAO AS USSR). It consists of a 1 kc/s generator, a pulse shaper, a frequency divider, an output cascade and a supply unit. The divider has a ratio of 1000 and gives signals at intervals of one second; the standard variation of daily running does not exceed 0.00015 second, corresponding to a relative change in frequency of 1.7×10^{-9}. The generator uses a quartz resonator under series resonance conditions. The tuning fork is a frequency filter in the feedback circuit of the amplifier which is based on two transistors. The quartz generator, in a special container, is attached to a cable and lowered down a bore hole to a depth of 35 m where the temperature is 12.6°C. The frequency divider is a three decade ring circuit to which, for stable operation, impulses of negative polarity must be applied with an amplitude of
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S/115/63/000/003/004/010
E194/E455

A transistorized quartz clock

10 V and a duration of 3 to 5 μ sec. The construction is briefly described and circuit diagrams are given. Temperature variations in the range 15 to 50°C do not affect operation of the frequency divider or the pulse shaping device. The quartz clock was compared with a quartz clock of Rode and Schwartz and the standard variation calculated over a month ranged from 0.9×10^{-9} to 1.7×10^{-9}. The instrument is of sufficiently simple construction for it to be made in any laboratory concerned with accurate measurement of time. There are 4 figures.

Card 2/2

IVAKIN, V.M.; IL'KIV, M.I.

Electronic-mechanical device for determining mean moments of star transits. Izv. GAO 23 no.4:103-105 '64.

(MIRA 17:9)

IVAKIN, V.N.

Basic indexes in the development of the public health system of the R.S.F.S.R. at the beginning of 1961. Zdrav. Ros. Feder. 5 no.6: 44-47 Je '61. (MIRA 14:6)

(PUBLIC HEALTH—STATISTICS)

IVAKIN, V.V., red.

[Reconstruction of old Ural dams] Rekonstruktsiia starykh ural'skikh plotin. Sverdlovsk, 1956. 45 p. (MIRA 14:3)

(Ural Mountain region--Dams)

IVAKIN, V.V.; MOSKVINA, E.T.

Method of investigating the runoff of small rivers of the Urals. Trudy Otd.ekon.issl. UFAN SSSR no.3:19-42 '58. (MIRA 13:6)

(Miass Valley--Runoff)

IVAKIN, V.V.

Depression curve associated with a nonfree percolation during injection into a soil unsaturated by water. Trudy Gor.-geol. inst. UFAN SSSR no. 32:343-355 '59. (MIRA 14:5)
(Soil percolation)

IVAKIN, V.V.; ZHARIKOV, S.S.

Determining the standard evaporation from reservoir surface in the upper Miass Valley. Trudy Gor.-geol. inst. UFAN SSSR no.40:199-210 '59. (MIRA 13:11)

(Miass Valley--Evaporation)

KOVALEV, Vladimir Fedorovich; IVAKIN, V.V., kand.tekhn.nauk; RYZHIKOV, D.V. [deceased], kand.geol.-min.nauk; ARDASENOVA, L.P., red.izd-va; EBERGARDT, M.S., red.izd-va; SEREDKINA, N.F., tekhn.red.

[Underground waters in the central and northern trans-Ural region, and oil and gas potentials] Podzemnye vody Srednego i Severnogo Zaural'ia i voprosy gazoneftenosnosti. Sverdlovsk, 1960. 60 p. (Akademiia nauk SSSR. Ural'skii filial, Sverdlovsk. Gorno-geologicheskii institut. Trudy, no.47) (MIRA 14:1)
(Ural Mountain region--Water, Underground)
(Ural Mountain region--Petroleum geology)

IVAKIN, V.V.

Brief hydrogeological characteristics and specific features of the formation of subsurface flow in the upper part of the Miass Basin. Trudy Gor.-geol. inst. UFAN SSSR no. 48:111-122 '60. (MIRA 14:2)

(Miass Valley—Water, Underground)

IVAKIN, V.V.; KHRUSHCHEV, G.N.

Practice of using pressureless hydraulic transportation in Mine No.76/75. Trudy Inst. gor. dela UFAN SSSR no.3:95-99 '62. (MIRA 16:3)

(Kizel Basin—Hydraulic conveying)

IVAKIN, V.V.

Methods of designing pressureless hydraulic coal conveying. Trudy Inst. gor. dela UFAN SSSR no.3:101-113 '62. (MIRA 16:3)
(Hydraulic conveying)

IVAKIN, V.V.

Determining probable rates of the maximum annual water inflows in mines during the development of deep horizons as revealed by a study made in some mines in the Kizel Basin. Trudy Inst. geol. UFAN SSSR no.69. Gidrogeol. sbor. no.3:169-178 '64.

(MIRA 17:11)

IVAKIN, Yu.A., mashinist teplovoza

What can be learned from the experience in the operation of TE10 diesel locomotives. Elek. i tepl.tiaga 6 no.8:20-21 Ag '62. (MIRA 17:3)

1. Podmennyy punkt stantsii Artizian Severo-Kavkazskoy dorogi.

80238

16.9000 S/166/60/000/02/06/013

AUTHOR: Ivakin-Trevogin, G.N.

TITLE: On the Solution of the System of Equations of Khinchin

PERIODICAL: Izvestiya Akademii nauk Uzbekskoy SSR, Seriya fiziko-matematicheskikh nauk, 1960, No.2, pp. 55-60

TEXT: Khinchin has calculated the time of waiting of a work-bench if one worker serves several work-benches. In (Ref.1) the calculation supposes the solution of a certain system of equations which is proposed by Khinchin to be carried out numerically. The author shows that in a special case (n equal work-benches the waiting times of which are distributed exponentially) the mentioned system of equations admits a rigorous solution which is given by a simple algebraic expression. In particular the results of Khinchin (Ref.1), Palm (Ref.2,3) and the author (applied in 1929 for the standardization of the works in the factory No.12 "Mostrikotazh") agree in this special case. There are 3 references: 1 Soviet, 1 Swedish and 1 American.

ASSOCIATION: Institut matematiki im.V.I.Romanovskogo AN Uz SSR (Mathematical Institute im.V.I.Romanovskiy AS Uz SSR)

SUBMITTED: June 9, 1959

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20897

3.1540 (1062,1128,1184)

S/034/60/000/208/002/004
E032/E314

AUTHORS: Chistyakov, V.F. and Ivakina, I.P.

TITLE: High Eruptive Activity on the Sun

PERIODICAL: Astronomicheskiy tsirkulyar, 1960, No. 208. pp. 12 - 13

TEXT: On December 4-5, 1959, between 23^h36^m and 03^h36^m UT the Ussurka Solar Station (АФР-2 (AFR-2) telescope) noted an unusually high eruptive activity in the active region near the centre of the solar disc. The heliographic coordinates of the leaders of the bipolar group were as follows: head - $\varphi = +10^o$, $L = 236^o$; tail - $\varphi = +10^o$, $L = 228^o$. During 4 hrs 15 minutes of observations seven flares were noted in this region, two of which were "1+" flares with maxima at $0^h36^m.5$ and 1^h21^m. The most interesting and unusual features were eruptions which were frequently ejected in groups in the form of a fan. The centre of the radial system of ejections was a fine spot ($\varphi = +9^o$, $L = 238^o$) which, during subsequent days, grew in area and had a darker nucleus. Analysis of the

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S/034/60/000/208/002/004
E032/E314

High Eruptive Activity ....

film showed that during a single hour (23^h37^m - 0^h37^m) 30 eruptions occurred in this region in the form of isolated rays. The number of eruptions was then as follows: 0^h37^m - 1^h37^m - 12 eruptions and 1^h37^m - 2^h37^m - 12 eruptions and 2^h37^m - 3^h37^m - 18 eruptions. The longest rays extended over 15^o along the Equator (180 000 km) and were darker than the stable filaments. The approximate instants of the most powerful eruptions (eruptive fan) were as follows: 23^h52^m - 57^m, 0^h21^m - 28^m, 0^h37^m - 59^m, 1^h44^m and 2^h37^m - 48^m. Radio observations on 1.44 m (208 Mc/s) were carried out in parallel between 23^h and 2^h. The intensity was as follows: December 1 - 25 x 10^{-22}, December 2 - 49 x 10^{-22}, December 3 - 108 x 10^{-22}, December 4 - 27 x 10^{-22} and December 5 - 19 x 10^{-22} $Wm^{-2}c.p.s.^{-1}$. During the observations of December 5, the intensity remained constant

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High Eruptive Activity ....

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E032/E314

to within 5%. Five major radio bursts were recorded during the observations:

Time	Amplitude x 10^{22} W m^{-2} c.p.s.$^{-1}$
23^h19^m - 23^h22^m	300
23^h54^m - 23^h56^m	200-250
0^h12^m - 0^h15^m	250
0^h21^m - 0^h29^m	200
0^h33^m - 0^h35^m	400 .

According to the local magnetic station, a magnetic storm with sudden commencement began on December 5, 1959 at 6^h 59^m UT and continued for about twelve hours.

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High Eruptive Activity ....

S/034/60/000/208/002/004
E032/E314

ASSOCIATION: Dal'nevostochnyy filial Sibirskogo otdeleniya AN SSSR (Far-Eastern Branch of the Siberian Division of the AS USSR)

SUBMITTED: December 9, 1959

Card 4/4

L 19004-65 EWT(m)/EPF(c)/EPR/EWP(j)/T Pc-4/Pr-4/Ps-4 RPL RM/WW

ACCESSION NR: AP5000715

S/0191/64/000/012/0006/0009

AUTHOR: Berlin, A.A., Kefeli, T.Ya., Sivergin, Yu.M., Filippovskaya, Yu.M., Ivakina, L.P., Shashkova, V.T.

TITLE: Properties of cured polyester acrylates with varying polymerization coefficients

SOURCE: Plasticheskiye massy, no. 12, 1964, 6-9

TOPIC TAGS: polyacrylic resin, polyester acrylate, cured polymer, polymer mechanic property, polymerization coefficient, polymerization initiator, polymethacrylate

ABSTRACT: Homologs of ... methacrylate-bis-(diethyleneglycol) phthalate (MDF) with ... [illegible] ... homopolymerized or copolymerized ... [illegible] ... decrease in hardness and increase ... with increasing length and flexibility of the ... [illegible] ... maximum ... [illegible] ... 500 ... and having the general formula ... [illegible] ... polymerization were ... anhydride, diethylene glycol and methacrylic ... [illegible] ... polymers were glassy or elastomeric solids, depending on ...

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L 19004-65
ACCESSION NR: AP5000745

the coefficient of polymerization, and the mechanical strength of the copolymers was slightly improved as compared with the properties of the homopolymers. The increase in tensile strength with a decrease in the coefficient of polymerization from 5 to 2 is ascribed to an [illegible] crosslinking, while the lower strength at a coefficient of [illegible] is ascribed to structural stress and a decrease in orientation capability. Swelling tests in acetone vapor proved [illegible] of the oligomer block [illegible] expected [illegible] [illegible] [illegible] Orig. art. has: [illegible] tables, [illegible] figures and [illegible] chemical formula.

ASSOCIATION: None

SUBMITTED: 00 ENCL: 00 SUB CODE: MT

NO REF SOV: 008 OTHER: 005

Card 2/2

IVAKINA, K.N. (Voronezh)

A case of epidemic cerebrospinal meningitis with six relapses.
Klin.med. 36 no.9:138-139 S'58 (MIRA 11:10)

1. Iz kafedry infektsionnykh bolezney (zav. prof. N.P. Patrik)
Voronezhskogo meditsinskogo instituta.
(MENINGITIS, case reports
cerebrospinal meningitis with six relapses (Rus))

BOLDYREV, B.G.; IVAKINA, M.A.

Some analogues of pseudoallicin ($C_6H_{10}O_2S_2$). Nauch. zap. LPI no.29:109-120 '55. (MLRA 9:10)

(Allicin) (Antibiotics)

AVERBUKH, Ya.D.; IVAKINA, M.A.

Crystallization on heat transmitting walls in a circulating boiling liquid. Izv. vys. ucheb. zav.; khim. i khim. tekh. 4 no. 2:326-327 '61. (MIRA 14:5)

1. Ural'skiy politekhnicheskiy institut im. S.M. Kirova. Kafedra protsessov i apparatov.

(Boilers--Incrustation)

NESIS, A.I.; VINARIK, E.M.; DVOYRIN, V.L.; DZHANGOZINA, D.M.; KLYATSKINA, I.Ye.; FADEYEVA, Ye.I.; SHNAYDMAN, I.M.; IVAKINA, T.P.

Regression of experimental silicosis under the influence of hydrocortisone. Izv. AN Kazakh. SSR Ser. med. nauk 11 no.3: 44-49 '64 (MIRA 18:1)

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IVAKINA, T. Ya.

PHASE I BOOK EXPLOITATION SOV/5575

Akademiya nauk SSSR. Astronomicheskiy sovet.

Byulleten' stantsiy opticheskogo nablyudeniya iskusstvennykh sputnikov Zemli, no. 6. (Bulletin of the Stations for Optical Observation of Artificial Earth Satellites. No. 6) Moscow, 1959. 23 p. 500 copies printed.

Sponsoring Agency: Astronomicheskiy sovet Akademii nauk SSSR.

Resp. Ed.: Ye. Z. Gindin; Secretary: O. A. Severnaya.

PURPOSE : This bulletin is intended for scientists and engineers concerned with optical tracking of artificial satellites.

COVERAGE : The bulletin contains 9 articles which present the results of satellite observations, and describe methods and specific equipment used for photographic observation of earth satellites. An appendix contains a listing of 84 Soviet satellite observation stations with station number. No personalities

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are mentioned. There are no references.

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KALIKHEVICH, F.; IVAKINA, T.; DUBYAGO, I.A., nauchnyy sotrudnik; SENTSOVA, Yu.Ye., nauchnyy sotrudnik

Results of photographic observations of artificial earth satellites. Biul.sta.opt.nabl.isk.sput.Zem. no.23:21-25 '61. (MIRA 15:3)

1. Nikolayevskaya stantsiya nablyudeniy iskusstvennykh sputnikov Zemli (for Kalikhevich, Ivakina).
(Artificial satellites--Tracking)

TUMANYAN, B.Ye.; KALIKHEVICH, F.F.; IVAKINA, T.Ya.; BRATIYCHUK, M.V.; BELENKO, V.I.; KRYLOV, A.G.; SENTSOVA, Yu.Ye.; SHILKINA, Z.S.; YUREVICH, V.A.; ZAKHAROV, V.N.

Results of photographic observations of artificial earth satellites. Biul.sta.opt.nabl.isk.sput.Zem. no.29:37-44 '62. (MIRA 16:2)

1. Nachal'nik Yerevanskoy stantsii nablyudeniya iskusstvennykh sputnikov Zemli (for Tumanyan). 2. Nikolayevskaya stantsiya nablyudeniya iskusstvennykh sputnikov Zemli (for Kalikhevich, Ivakina). 3. Nachal'nik Uzhgorodskoy stantsii nablyudeniya iskusstvennykh sputnikov Zemli (for Bratiychuk). 4. Zvenigorodskaya stantsiya Astronomicheskogo soveta AN SSSR (for Belenko, Krylov, Sentsova, Shilkina, Yurevich). 5. Nachal'nik Irkutskoy stantsii nablyudeniya iskusstvennykh sputnikov Zemli (for Zakharov).
(Artificial satellites—Tracking)

IVAKINA, V.A.

Implementation of the seven-year plan for the development of the network and growth of the personnel of public health agencies and institutions of the R.S.F.S.R. Med. sestra 22 no.10:5-6 O'63 (MIRA 16:12)

1. Nachal'nik otdela meditsinskoy statistiki Ministerstva zdravookhraneniya RSFSR.

IVAKINA, V. I.

Basic results of the development of the network, activity and trained personnel of the public health organs and institutions to the beginning of 1962. Zdrav. Ros. Feder. 6 no.8:43-46 Ag '62. (MIRA 15:7)

1. Nachal'nik otdela meditsinskoy statistiki Ministerstva zdravookhraneniya RSFSR.

(PUBLIC HEALTH--STATISTICS)

IVAKINA, V.N.

Statistical registration and accounting in medical institutions and public health organs. Zdrav. Ros. Feder. 4 no. 4: 45-48 Ap '60.
(MIRA 13:10)

(MEDICAL RECORDS)

IVAKINA, V.N.

Hospital registration documents. Zdrav. Ros. Feder. 4 no.5:48, 3 of cover. My '60. (MIRA 13:11)
(HOSPITALS--RECORDS AND CORRESPONDENCE)

IVAKINA, V.N.

Basic indicators of the development of the public health system of the R.S.F.S.R. at the beginning of 1960. Zdrav. Ros. Feder. 4 no.6: 47-3 of cover Je '60. (MIRA 13:9)

1. Nachal'nik otdela meditsinskoy statistiki Ministerstva zdravookhraneniya RSFSR. (PUBLIC HEALTH--STATISTICS)

IVAKINA, V.N.

Basic indexes of the development of the public health system of the R.S.F.S.R. according to the plan for 1960. Zdrav. Ros. Feder. 4 no.7:47-3 of cover Je '60. (MIRA 13:9)

1. Nachal'nik Otdela meditsinskoy statistiki Ministerstva zdravookhraneniya RSFSR.
(PUBLIC HEALTH—STATISTICS)

IVAKINA, V.N.

Basic indexes of the development of the public health system in the R.S.F.S.R. Zdrav. Ros. Feder. 4 no. 10:47-48 0 '60. (MIRA 13:10)

(PUBLIC HEALTH—STATISTICS)

IVAKINA, V.N.

Study of traumatism. Sov. med. 24 no. 10:148-150 O '60.
(MIRA 13:12)

1. Nachal'nik otdela statistiki Ministerstva zdravookhraneniya RSFSR.

(ACCIDENTS) (WOUNDS)

IVAKINA, V.N.

Basic indexes of the development of the public health system of the R.S.F.S.R. at the beginning of 1960. Zdrav. Ros. Feder. 4 no.12:41-43 D '60. (MIRA 13:12)

1. Nachal'nik otdela meditsinskoy statistiki Ministerstva zdravookhraneniya RSFSR.
(PUBLIC HEALTH--STATISTICS)

IVAKINA, V.N.; BRUSHLINSKAYA, L.A.

Statistics on public health. Zdrav. Ros. Feder. 5 no. 2:47-48 F '61.
(MIRA 14:2)

(DISEASES—REPORTING)